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$$\frac{du}{db} = \frac{2nb - 2S(y_1) + 2aS(x_1)}{1+a^2} = 0, \text{ or } S(y_1) - aS(x_1) - nb = 0, \qquad (3)$$

where $S(y_1) = y_1 + y_2 + \dots + y_n$. And

$$\frac{du}{da} = \frac{2aS(x_1^2) - 2S(x_1y_1) + 2bS(x_1)}{1+a^2}$$
$$- \frac{[S(y_1^2) + a^2S(x_1^2) + nb^2 - 2aS(x_1y_1) - 2bS(y_1) + 2abS(x_1)]2a}{(1+a^2)^2} = 0,$$

or $\quad a^2S(x_1y_1) - a^2bS(x_1) + a[S(x_1^2) - S(y_1^2)] - nab^2 + bS(x_1) + 2abS(y_1)$

$$- S(x_1y_1) = 0, \qquad (4)$$

where $S(x_1y_1) = x_1y_1 + x_2y_2 + \dots + x_ny_n$.

Eliminating b from (3) and (4) and solving for a,

$$a = \frac{S(y_1^2) - S(x_1^2) + [S(x_1)]^2 - [S(y_1)]^2}{2[S(x_1y_1) - S(x_1)S(y_1)]}$$
$$\pm \sqrt{\left[1 + \left(\frac{S(y_1^2) - S(x_1^2) + [S(x_1)]^2 - [S(y_1)]^2}{2[S(x_1y_1) - S(x_1)S(y_1)]}\right)^2\right]}. \qquad (5)$$

Equation (3) shows that the line passes through the centre of gravity of the n points, and therefore by (2) it must be a principal axis of them. And by (5) there are two positions of the line, at right angles to each other, which make $S(d_1^2)$ a minimum. The first value of a which gives the least minimum is the one which the problem requires.

$x_1 = 1, y_1 = 1, x_2 = 3, y_2 = 2, x_3 = 5, y_3 = 4$, gives

$$a = \frac{1+4+16-1-9-25+(1+3+5)^2-(1+2+4)^2}{2[(1+6+20)-(1+3+5)(1+2+4)]} \pm \sqrt{\left(1+\frac{1}{16}\right)}$$
$$= -\tfrac{1}{4} \pm \tfrac{1}{4}\sqrt{17} = .78078 \text{ or } 1.2808.$$

NOTE ON THE QUANTITY g, PAGE 25, BY PROF. JOHNSON.—The value of this quantity is

$$g_n = \tfrac{1}{3}(2^n \pm 1);$$

for, beginning with $g_0 = 0$, we have, from the given relation

$$g_{n-1} = 2g_n \pm 1,$$

$g_1 = 1, g_2 = 2 - 1, g_3 = 2^2 - 2 + 1$, and in general $g_n = 2^{n-1} - 2^{n-2} + 2^{n-3} \dots$, whence

$$g_n = \frac{2^n \pm 1}{2+1}.$$

In the table an error occurs in the value of g_{19} which introduces a cumulative error in the subsequent values, and another error was made in forming g_{28}; the final value should be

$$g_{50} = 375{,}299{,}968{,}947{,}541.$$